37. (New) A computer-readable medium on which are stored instructions that, when executed by one or more nodes in a mesh network, carry out a method for rerouting communications between first and second nodes of the network upon a failure in a first path between the first and second nodes, the method comprising rerouting the communications over a second path identified prior to said failure, the second path being node and span disjoint from the first path and the communications in the second path being carried over at least one assigned channel in at least one transmission line between at least one pair of nodes of the second path, said rerouting including assigning said at least one channel after said failure occurred.

38. (New) The computer-readable medium of claim 37 wherein said method carries out said rerouting by assigning bi-directional channels in transmission lines of the second path in a direction from the first node toward the second node and concurrently assigning bi-directional channels in transmission lines of the second path in a direction from the second node toward the first node.

REMARKS

Objection to Drawings

The drawings were objected to on the grounds that certain reference numerals mentioned in the specification are not shown in FIG. 2. This objection is respectfully traversed in that the reference numerals 201, 203, etc. pointed to in the Office action do not appear anywhere in the specification and, in fact, applicants did not intend to include in FIG. 2 any elements with those reference numerals.

Applicants presume that the basis of the examiner's objection is the fact that the specification refers to nodes 200-218 and transmission lines 250-272, whereas FIG. 2

only includes nodes 200, 202, etc. and transmission lines 250, 252, etc. Applicant does not believe that a person reading the specification and drawing together would think that applicants intended to include any elements denoted 201, 203, etc. However, the specification has been amended to more clearly indicate which reference numerals the ranges 200-208 and 250-272 actually encompass.

Rejection of Claims

Claims 1-20 were rejected under 35 U.S.C. 102(e) as being anticipated by Chaudhuri.

Claims 2, 6 and 14 have been canceled.

Various ones of the claims, including both of the independent claims 1 and 13, have been amended to more particularly define the invention and to distinguish it from Chaudhuri. In view of these amendments, it is believed that claims 1, 3-5, 7-13 and 15-20 are all in condition for allowance.

In addition, various ones of the claims have been amended to correct minor errors and to improve their form generally.

New claims 21-38 have been added.

Independent Claims 1 and 13

Amended independent claims 1 and 13 now set forth two particular requirements for the recited second path, i.e., the path over which the communication signal is rerouted when an error condition is detected. The first of those requirements is that the second path is determined *before* the error condition is detected. The second of those requirements is that the channels within the transmission lines that are included in the second path are assigned to carry the communication signal over the second path *after* the error condition is detected. That is, the specific series of nodes—the path—over which the signal to be communicated between the end nodes is determined ahead of time, so that it can be immediately put into use when it is time to switch from the first path to the

second path. However, the specific channels that are to carry the communication signal within that path are *not* assigned ahead of time. Rather, the channels are assigned only after it has been decided that communications should be carried out over the second path. Assigning the channels in this way allows channel resources to be efficiently allocated during a restoration process, for example, without causing significant delays. See, for example, page 10, lines 10-12 and page 11, lines 24-29 of the specification.

In all of the prior art of which applicants are aware, either a) both the restoration node routing and the channel assignments are determined before an error condition is detected or b) both are determined after an error condition is detected. Applicants are aware of no prior art in which, as in applicants' invention, the restoration node routing—the "path" of applicants' claims—is pre-determined but the channel assignments along the route are assigned, or determined, only after the restoration is initiated.

The cited Chaudhuri reference is of the first type of prior art. That is, both the restoration node routing and the channel assignments along the route are predetermined. In particular, Chaudhuri discloses a path database 26 in which pre-computed paths are stored. These are downloaded to the various nodes and are continually updated. In the event that it is necessary to have the signals between a pair of nodes rerouted, steps are taken to have those signals rerouted over one of the predetermined paths.

Significantly, Chaudhuri is very clear and consistent in its use of the word "path" as meaning not just the restoration node routing, but the specific channels as well. The examiner's attention is respectfully directed in this regard to the following illustrative passages in Chaudhuri (emphasis added):

> The set of channels in links 14_3, 14_{10} and 14_9 ... comprises a "path." (col. 3, lines 35-38).
>
> Another exemplary path comprises channel ßx in link 14_1, channel $\delta\epsilon$ in link 14_9, channel $\Phi\gamma$ in link 14_6 coupling the end-point node ports 19B and 19G. (col. 3, lines 39-41).
>
> The Path database 26 includes records containing information about each path, that is, the collection of channels in links ... (col. 4, lines 6-8).

Thus it is clear that both the node routing *and* the specific channels are pre-computed in Chaudhuri. As such, Chaudhuri cannot be said to anticipate the recitation in, for example, both amended independent claim 1 and amended independent claim 13 "at least one said channel being assigned to carry the communication signal after the error condition is detected." (Claim 1, lines 14-15; claim 13, lines 15-17 [emphasis added]).

Language directed to the above-discussed aspect of the invention appeared in, for example, claims 2 and 14, which have now been canceled. The Office action had rejected those claims, citing col. 4, lines 53-56 of Chaudhuri. It is respectfully submitted, however, that neither the cited passage in Chaudhuri, nor any other teaching in Chaudhuri, discloses the notion of determining the channels of a pre-computed restoration node routing after the error condition is detected. The Office action, in particular, points to Chaudhuri's statement at lines 53-56 that the restoration path computation could be based on the shortest path. However, knowing that the restoration path may be computed based on determining which path is the shortest does not say anything about whether the channels that form that path are determined before or after an error event. Indeed, it is clear that, contrary to applicants' claims, Chaudhuri's arrangement determines the channel assignments *before* the error event. In particular, as already noted, a) Chaudhuri uses the term "path" to mean both the node routing and the channel assignments, and b) Chaudhuri's paths are pre-computed and downloaded to the various nodes prior to the occurrence of the error condition for immediate use if and when an error condition occurs thereafter.

In view of the foregoing, it is respectfully submitted that claims 1 and 13 patentably distinguish applicants' invention from Chaudhuri. Moreover, inasmuch as each of the dependent claims in the application necessarily includes all of the limitations of one or the other of independent claims 1 and 13, it is respectfully submitted that each of those claims patentably distinguishes the invention from Chaudhuri for at least the reasons given above. However, applicants specifically direct the examiner's attention to certain of the dependent claims, which even more particularly distinguish the invention from Chaudhuri, as will now be discussed.

Dependent Claim 3

Claim 3 recites that one or more back-off commands is sent to release at least one channel used to reroute the communication signal. The Office action points to col. 5, lines 19-22 of Chaudhuri as anticipating these recitations. However, the cited portion of Chaudhuri is directed to a discussion of how the various pre-computed paths are, in fact, pre-computed. Chaudhuri is not discussing the actual releasing of channels, i.e., the removal of a channel from a communication route. The "removing" that is mentioned in Chaudhuri simply means that once a channel has been assigned to a particular pre-computed path during the pre-computation process, that channel is removed from consideration for the computation of other paths.

Dependent Claims 7-10, 17 and 18

Claims 7-10, 17 and 18 have been amended to more particularly define the various alternative techniques disclosed by applicants for carrying out the channel assignment.

Amended claim 7, in particular, is directed a particular embodiment of the invention wherein, after the error condition is detected, a bi-directional channel assignment process proceeds from both of the end nodes. This technique expedites restoration of the network. See, for example, page 14, line 25 et seq of the specification.

Amended claim 8 is directed to a particular embodiment wherein responsive to a failure indication sent from the first end node to the second end node, commands are issued from the second end node to the one or more second intermediate nodes to bi-directionally assign channels along the second path.

Amended claims 9 and 17 are directed to yet another alternative technique wherein commands are issued from the first end node to the one or more second intermediate nodes to unidirectionally assign channels along the second path in a first direction. And amended claims 10 and 18 add that commands are issued from the *second*

end node to the one or more second intermediate nodes to unidirectionally assign channels along the second path in a *second* direction.

The Office action points to various passages in Chaudhuri as having anticipated the language of original claims 7-10, 17 and 18. Whether or not the original language of these claims was anticipated by Chaudhuri, it is submitted that Chaudhuri neither shows nor suggests the technique set forth in these claims as amended.

Dependent Claims 12 and 20

These claims have been amended and recite that the assigning of channels uses a contention technique. As is well known in the art, "contention" is a phenomenon wherein two or more entities attempt to allocate to themselves or otherwise take control of, the same resource. That is, they "contend" for the resource. A contention technique undertakes to resolve that conflict. See, for example, page 15, lines 8-21 of applicants' specification. The Office action points to various passages in Chaudhuri as anticipating this feature. Applicants do not find anything in the cited passages that constitutes a "contention technique" in the sense that that term is used in the specification or understood in the art generally.

New Claims

New claims 21-38 have been added.

New independent claim 21, for example, is a method claim in which it is recited that the second path is node and span disjoint from the first path, that the second path was identified *prior* to the failure, and that at least one channel within the second path is assigned *after* the failure. This claim thus distinguishes the invention from Chaudhuri for at least the reasons set forth above relative to, for example, claim 1. New independent claims 25, 28, 31, 34 and 37 also include limitations directed to this aspect of the invention. It is thus believed that each of the new claims 21-38 patentably distinguishes the invention from Chaudhuri.

Dependent claims 22, 26, 29, 33, 36 and 38 even more particularly distinguish the invention from Chaudhuri. Like amended claim 7, these claims are directed to the unique feature of applicants' invention wherein, after the error condition is detected, a bi-directional channel assignment process proceeds from both of the end nodes.

In view of the foregoing, it is believed that all the claims in the application are now in condition for allowance, which action and passage of the application to issue are earnestly solicited.

Respectfully submitted,

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VERSION WITH MARKINGS SHOWING CHANGES

IN THE SPECIFICATION

Page 4, lines 18-23, amend the paragraph as follows:

--Fig. 2 is a block diagram of an exemplary optical mesh network 130 having a set of communication nodes having even-numbered reference numerals within the range 200-218 (hereinafter collectively referred to as nodes 200-218) interconnected through a series of transmission lines having even-numbered reference numerals within the range 250-272 (hereinafter collectively referred to as transmission lines 250-272). While Fig. 2 depicts an optical mesh network with ten nodes 200-218, it should be appreciated that the size of a mesh network is not important and mesh networks of any size can be used without departing from the spirit and scope of the present invention.--

IN THE CLAIMS

1. (Amended) A method that restores communication in a mesh network between a first end node and a second end node, comprising:

transmitting a communication signal over a first communication path comprising the first end node, the second end node and one or more first intermediate nodes;

detecting an error condition ~~in~~ at at least one of the first end node and the second end node; and

rerouting the communication signal over a second communication path based on the detected error condition in order to restore communication, the second path having been determined before the error condition is detected and the second path including the first end node, the second end node, and one or more second intermediate nodes, wherein

the second intermediate nodes are disjoint from the one or more first intermediate nodes ~~to restore communication~~;

the second path further including one or more transmission lines each having a plurality of channels, at least one said channel being assigned, after the error condition is detected, to carry the communication signal.

3. (Amended) The method of claim ~~2~~1, further comprising sending one or more back-off commands to release at least one channel ~~used to reroute~~ that had been assigned, after the error condition had been detected, to carry the communication signal.

4. (Amended) The method of claim 1, wherein the first and second end ~~node~~ nodes coordinate rerouting the communication signal over the second path.

5. (Unchanged) The method of claim 1, wherein the mesh network is an optical mesh network.

7. (Amended) The method of claim 1, wherein the step of rerouting the communication signal includes

issuing commands, after the error condition is detected, in a direction from the first end node to at least one of the ~~one or more~~ second intermediate nodes to bi-directionally ~~reroute the communication signal along the second path~~ assign channels in at least one of said transmission lines, and

issuing commands, after the error condition is detected, in a direction from the second end node to at least one of the second intermediate nodes to bi-directionally assign channels in at least one of said transmission lines.

8. (Amended) The method of claim 1, wherein the step ~~or routing~~ of rerouting the communication signal includes:

responding to ~~sending~~ a failure indication sent from the first end node to the second end node~~; and~~ by

issuing commands from the second end node to the one or more second intermediate nodes to bi-directionally ~~reroute the communication signal~~assign channels along the second path.

9. (Amended) The method of claim 1, wherein the step of rerouting the communication signal includes issuing commands from the first end node to the one or more second intermediate nodes to unidirectionally ~~reroute the communication signal~~ assign channels along the second path in a first direction.

10. (Amended) The method of claim 9, wherein the step of rerouting the communication signal further includes issuing commands from the second end node to the one or more second intermediate nodes to unidirectionally ~~reroute the communication/signal~~ assign channels along the second path in a second direction.

11. (Unchanged) The method of claim 1, wherein the mesh network is a synchronous optical network (SONET) defined by the ANSI T1.105.

12. (Amended) The method of claim 1, wherein ~~rerouting the communication signal~~ channels are assigned to carry the communication signal over the second path ~~uses~~ using a contention technique.

13. (Amended) A ~~self-healing~~ mesh network having a first end node and a second end node, comprising:

a first communication path that transmits a communication signal, the first communication path including the first end node, the second end node and one or more first intermediate nodes;

an error detecting device in at least one of the first end node and the second end node; and

a predetermined second communication path that is determined before the error detecting device detects an error condition and that transmits the communication signal

after the error detecting device detects ~~an~~ the error condition, the predetermined second path ~~consisting of~~ comprising the first end node, the second end node, and one or more second intermediate nodes, wherein the second intermediate nodes are disjoint from the one or more first intermediate nodes;

the second path further including one or more transmission lines each having a plurality of channels, and at least one said channel being assigned, after the error condition is detected, to carry the communication signal.

15. (Amended) The ~~self-healing~~ mesh network of claim 13, wherein the communication signal is rerouted from the first ~~communication~~ path to the second path based on an error condition ~~from~~ detected by the error detecting device.

16. (Amended) The ~~self-healing~~ mesh network of claim 13, wherein the communication signal is rerouted from the first ~~communication~~ path to the second path based on a communication of the second end node.

17. (Amended) The ~~self-healing~~ mesh network of claim 13, wherein the first end node responds to an error condition by issuing ~~issues~~ commands to the one or more second intermediate nodes to unidirectionally ~~reroute the communication signal~~ assign channels along the second path in a first direction~~,~~.

18. (Amended) The ~~self-healing~~ mesh network of claim 17, wherein the second end node responds to the error condition by issuing~~issues~~ commands to the one or more second intermediate nodes to unidirectionally ~~reroute the communication signal~~ assign channels along the second path in a second direction.

19. (Amended) The ~~self-healing~~ mesh network of claim 13, wherein the mesh network uses a synchronous optical network (SONET) defined by the ANSI T1.105.

20. (Amended) The ~~self healing~~ mesh network of claim ~~1~~413, wherein one or more channels of at least one ~~second~~ of said transmission lines ~~is determined~~ are assigned to carry the communication signal using a contention technique.

Add new claims 21-38 as follows:

21. (New) A method for rerouting communications between first and second nodes of a mesh network upon a failure in a first path between the first and second nodes, the method comprising rerouting the communications over a second path identified prior to said failure, the second path being node and span disjoint from the first path and the communications in the second path being carried over at least one assigned channel in at least one transmission line between at least one pair of nodes of the second path, said rerouting including assigning said at least one channel after said failure occurred.

22. (New) The method of claim 21 wherein said assigning further includes

assigning bi-directional channels in transmission lines of the second path in a direction from the first node toward the second node and concurrently assigning bi-directional channels in transmission lines of the second path in a direction from the second node toward the first node.

23. (New) The method of claim 21 wherein the mesh network is an optical network.

24. (New) The method of claim 21 wherein the mesh network is a synchronous optical network (SONET) defined by ANSI T1.105.

25. (New) A method for use in a mesh network comprising nodes interconnected by links, the method comprising

establishing a first communication path from a first node to a second node, the first communication path including ones of said links and at least one intermediate node;

directing communications traffic from the first end node to the second end node over the first path; and

responsive to a failure in the first path, rerouting the traffic to a second communication path that had been identified prior to said failure, the second path including ones of said links and at least one intermediate node, the second path being node and span disjoint from the first path, and the traffic over the second path being directed over at least one assigned channel within a multichannel link of the second path that was assigned subsequent to said failure.

26. (New) The method of claim 25 wherein said rerouting includes

assigning bi-directional channels in links of the second path in a direction from the first node toward the second node and concurrently assigning bi-directional channels in transmission lines of the second path in a direction from the second node toward the first node.

27. (New) The method of claim 25 wherein the mesh network is a synchronous optical network (SONET) defined by ANSI T1.105.

28. (New) A method for use in a mesh network comprising nodes interconnected by transmission lines, at least ones of the transmission lines being capable of carrying communication traffic in a plurality of channels, the method comprising

establishing a first communication path between a first node and a second node, the first communication path including ones of the transmission lines and at least one intermediate node;

directing communications traffic from the first end node to the second end node over assigned channels of the transmission lines in the first path; and

responsive to a failure in the first path, rerouting the traffic over assigned channels in the transmission lines of a second communication path between the first node and the second node, the second communication path having been identified prior to said failure, the second path having at least one intermediate node, the second path having no intermediate nodes or transmission lines in common with the first path, and at least one of the channels in the transmission lines of the second path being assigned subsequent to said failure.

29. (New) The method of claim 28 wherein said rerouting includes assigning bi-directional channels in transmission lines of the second path in a direction from the first node toward the second node and concurrently assigning bi-directional channels in transmission lines of the second path in a direction from the second node toward the first node.

30. (New) The method of claim 28 wherein the mesh network is a synchronous optical network (SONET) defined by ANSI T1.105.

31. (New) A node for use as a first node in a mesh network of a type in which communications signals between said first node and a second node of said network over a first path through said network are rerouted over a second path through said network upon a failure in said first path, said second path having been identified prior to said failure, the second path being node and span disjoint from the first path, said first node being arranged to initiate, after said failure in said first path, an assignment of channels, within links connecting pairs of nodes in the second path, to carry said communications signals.

32. (New) The invention of claim 31 wherein an identification of said second path is stored in said first node.

33. (New) The node of claim 32 wherein said assignment includes

assigning bi-directional channels in links of the second path in a direction from said first node toward the second node irrespective of whether said second node has initiated concurrent assignment of bi-directional channels in links of the second path in a direction from the second node toward said first node.

34. (New) A method for use by a first node in a mesh network of a type in which communications signals between said first node and a second node of said network over a first path through said network are rerouted over a second path through said network upon a failure in said first path, said second path having been identified prior to said failure, the second path being node and span disjoint from the first path, said method comprising initiating, after said failure in said first path, the assignment of channels, within links connecting pairs of nodes in the second path, to carry said communications signals.

35. (New) The invention of claim 34 wherein an identification of said second path is stored in said first node.

36. (New) The node of claim 35 wherein said assignment includes assigning bi-directional channels in links of the second path in a direction from said first node toward the second node irrespective of whether said second node has initiated concurrent assignment of bi-directional channels in links of the second path in a direction from the second node toward said first node.

37. (New) A computer-readable medium on which are stored instructions that, when executed by one or more nodes in a mesh network, carry out a method for rerouting communications between first and second nodes of the network upon a failure in a first path between the first and second nodes, the method comprising rerouting the communications over a second path identified prior to said failure, the second path being node and span disjoint from the first path and the communications in the second path being carried over at least one assigned channel in at least one

transmission line between at least one pair of nodes of the second path, said rerouting including assigning said at least one channel after said failure occurred.

38. (New) The computer-readable medium of claim 37 wherein said method carries out said rerouting by assigning bi-directional channels in transmission lines of the second path in a direction from the first node toward the second node and concurrently assigning bi-directional channels in transmission lines of the second path in a direction from the second node toward the first node.